

TECHNICAL MEMORANDUM

TO: Mark Taylor/David Porter, SOUTHDIV
John Karlyk, SOUTHDIV
Brian Donaldson, EPA Region IV
Jim Morrison, TDEC
Rob Williamson/Randy Wilson, NSA Memphis
Jack Carmichael, USGS
Brenda Duggar, MSCHD
John Stedman, E/A&H

FROM: Robert Smith, EnSafe/Allen & Hoshall

DATE: April 11, 1997

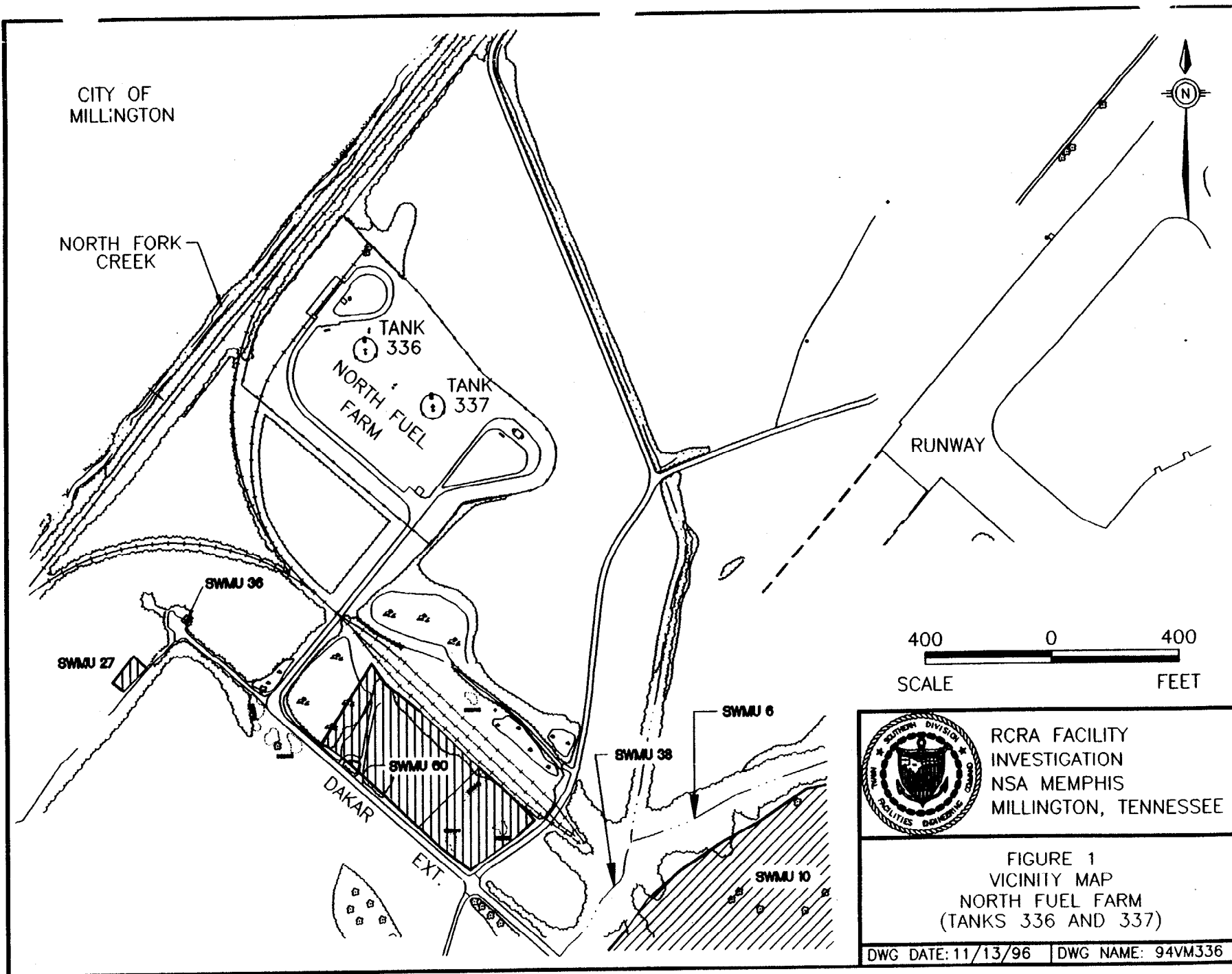
RE: North Fuel Farm (Tanks 336/337) Investigation, NSA Memphis,
Millington, TN; Revision: 3

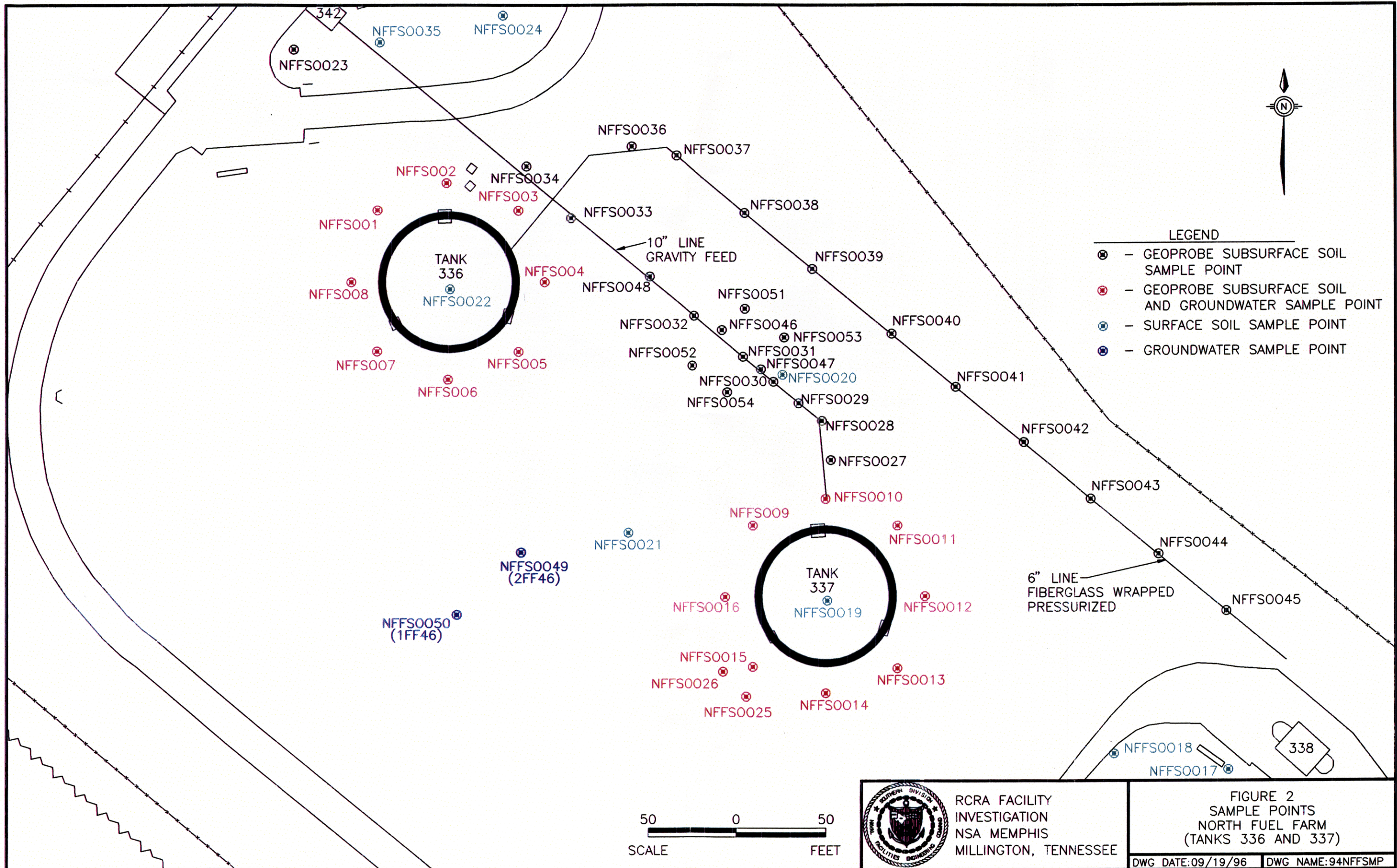
INTRODUCTION

The Navy, through EnSafe/Allen & Hoshall (E/A&H), conducted a soil and groundwater investigation in June 1996 at the North Fuel Farm in the northwest portion of the Naval Support Activity (NSA) Memphis Northside (Figure 1). The North Fuel Farm consists of two 420,000-gallon, field-constructed, concrete diesel fuel tanks (Tanks 336 and 337) and the associated piping and dispensing equipment. The North Fuel Farm is in an area of NSA Memphis Northside scheduled for closure under the Base Closure and Realignment Act of 1990 (BRAC). This area is scheduled to be transferred to the City of Millington; reportedly the city intends to use one of the tanks as nonpotable water storage for fire protection.

PREVIOUS INVESTIGATIONS

There have been no previous environmental investigations regarding Tanks 336 and 337. However, in November 1995, E/A&H collected groundwater samples from the North Fuel Farm area for the NSA Memphis Northside groundwater investigation. Fluvial deposits groundwater samples were collected from 46 feet below land surface (bls) at points 1FF46 and 2FF46 (Figure 2). Trichloroethylene (TCE) was detected in only one sample (2FF46) at a concentration of 6.8 micrograms per liter ($\mu\text{g/L}$). No soil data existed for this site before the current (June 1996) investigation.





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SAMPLING RATIONALE

E/A&H used a Geoprobe sampling system to collect subsurface soil and groundwater samples around both tanks, and soil samples from beneath the two main pipelines to determine if contamination has resulted from any leaks and/or spillage during past operations. Soil samples were collected from intervals corresponding to the bottom of the tanks and the pipelines (estimated to be 13 to 15 feet bls and 3 to 7 feet bls, respectively). Samples were collected in accordance with the *NAS Memphis Comprehensive RFI Work Plan* (E/A&H, 1994). The analytical results from the subsurface soil samples are presented in the Sample Results section below.

Surface-soil samples were also collected across the site to prepare a preliminary risk evaluation (PRE). The data from these samples are presented in the Sample Results section and discussed in the Preliminary Risk Evaluation section below.

Groundwater samples were collected at points adjacent to the tanks from 50 feet bls to determine if the fluvial deposits groundwater has been impacted. Groundwater samples were also collected from the previous locations of samples 1FF46 and 2FF46 to confirm the previous detection of TCE in the fluvial deposits groundwater. Groundwater sampling results are discussed in the Sampling Results section below.

The subsurface soil samples were split between an onsite laboratory (TEG of Lillburn, Georgia) and an offsite laboratory, Environmental Testing and Consulting (ETC of Memphis, Tennessee). Onsite analyses consisted of volatile organic compounds (VOCs) analysis using U.S. Environmental Protection Agency (USEPA) Methods 8010 and 8020 for both soil and groundwater. Offsite analysis included total petroleum hydrocarbons — gasoline range organics (TPH-GRO), and total petroleum hydrocarbons — diesel range organics (TPH-DRO) using Tennessee-modified Method 8015 for GRO and DRO. VOC analysis was selected because it can detect both chlorinated solvents such as TCE, as well as the petroleum constituents benzene, toluene, ethylbenzene, and xylenes (BTEX). Sample locations are presented in Figure 2.

Regulatory Action Levels

The potential contaminants of concern at the North Fuel investigation include petroleum-related constituents. The Tennessee Department of Environment and Conservation (TDEC) Underground Storage Tank (UST) Division has recently established uniform soil cleanup standards for petroleum releases that apply to both regulated and non-regulated UST sites, as well as non-tank-related sites (Tennessee Senate Bill 2720 [Public Chapter 864], May 3, 1996). These regulations, presented in the TDEC Division of UST *Environmental Assessment Guidelines* (August 1996), have established cleanup levels for both TPH and benzene in soil based on groundwater classification. Tables 1 and 2 present the criteria that are used to determine the site-specific cleanup standards under these regulations.

Table 1
TDEC Division of Underground Storage Tanks
Benzene Cleanup Levels (mg/kg)

Soil Permeability	> 10 ⁻⁴ cm/sec	10 ⁻⁴ to 10 ⁻⁶ cm/sec	< 10 ⁻⁶ cm/sec
Drinking Water	5	25	50
Non-Drinking Water	25	50	100

Notes:

cm/sec = centimeters per second

mg/kg = milligrams per kilogram (parts per million)

Table 2
TDEC Division of Underground Storage Tanks
TPH Cleanup Levels (mg/kg)

Soil Permeability	> 10 ⁻⁴ cm/sec	10 ⁻⁴ to 10 ⁻⁶ cm/sec	< 10 ⁻⁶ cm/sec
Drinking Water	100	250	500
Non-Drinking Water	250	500	1,000

Notes:

cm/sec = centimeters per second

mg/kg = milligrams per kilogram (parts per million)

The cleanup levels are based on two variables: soil permeability and groundwater classification. Groundwater is classified as a drinking water or a non-drinking water supply based in part on whether it exceeds USEPA drinking water standards.

Soil Permeability

Soil permeability data collected basewide from the loess during various investigations (RFI and UST) indicate coefficients of permeability that range from 4.8×10^{-6} to 1.6×10^{-8} cm/sec (Attachment A). Site specific permeability data (Attachment B), collected to determine the permeability of the loess in the area of Tanks 336 and 337, indicate a coefficient of permeability of 2.2×10^{-6} cm/sec. This puts the loess in the North Fuel Farm area in the 10^{-4} to 10^{-6} cm/sec range (Tables 1 and 2).

Groundwater

The groundwater classification was determined by comparing background loess groundwater samples to the primary and secondary drinking water standards as presented in the *Drinking Water Regulations and Health Advisory* (USEPA, 1996). As shown in Table 3, the background loess groundwater exceeds several of these standards, thus making the loess groundwater at NSA Memphis a non-drinking water source.

Table 3
Background Loess Groundwater Data vs. USEPA Drinking Water Standards

Sample ID	Date	Parameter	Units	Result	Drinking Water Standard	Standard
OBGG01LS01	21-Mar-95	Antimony	µg/L	20	6	Primary
OBGG01LS02	10-Nov-95	Antimony	µg/L	25	6	Primary
		Thallium	µg/L	3	2	Primary
OBGG02LS01	17-Mar-95	Antimony	µg/L	20	6	Primary
		Chromium	µg/L	167	100	Primary
		Lead	µg/L	33.6	15	Primary
		Nickel	µg/L	143	100	Primary

Table 3
 Background Loess Groundwater Data vs. USEPA Drinking Water Standards

Sample ID	Date	Parameter	Units	Result	Drinking Water Standard	Standard
OBGG02LS02	9-Nov-95	Antimony	µg/L	25	6	Primary
		Thallium	µg/L	3	2	Primary
OBGG04LS01	16-Mar-95	Antimony	µg/L	20	6	Primary
		Chromium	µg/L	213	100	Primary
		Nickel	µg/L	165	100	Primary
OBGG04LS02	9-Nov-95	Antimony	µg/L	25	6	Primary
		Cadmium	µg/L	5.4	5	Primary
		Chromium	µg/L	222	100	Primary
		Nickel	µg/L	157	100	Primary
		Thallium	µg/L	3	2	Primary
OBGG05LS01	17-Mar-95	Antimony	µg/L	40.5	6	Primary
		Chromium	µg/L	160	100	Primary
		Nickel	µg/L	114	100	Primary
OBGG05LS02	9-Nov-95	Antimony	µg/L	25	6	Primary
		Thallium	µg/L	3	2	Primary

Notes:

µg/L = micrograms per liter
 NTU = nephelometric turbidity units
 J = estimated

Based on the permeability of the loess at the North Fuel Farm, as well as the loess groundwater data, the applicable TDEC cleanup levels for TPH and benzene in North Fuel Farm soil are 500 mg/kg and 50 mg/kg, respectively.

SAMPLING RESULTS

The analytical results for the subsurface soil samples collected during this investigation (Table 4) indicate that one area near the southwest edge of Tank 337 has been impacted by past North Fuel Farm activities. Table 4 presents a summary of the detected compounds and their respective depth

intervals and concentrations. A complete summary of all samples collected, the analyses performed, and the respective concentrations are included as Attachment B.

Table 4
 NSA Memphis
 North Fuel Farm Geoprobe Soil Sample Results Summary - Hits Only - (mg/kg)

Parameters									
Area	Sample Point	Depth	TPH-DRO	TPH-GRO	Benzene	Toluene	Ethyl benzene	Xylenes (total)	BTEX (Total)
Tank 336	NFFS0006	13-15'	16.4	ND	ND	ND	ND	ND	ND
Tank 337	NFFS0015	6-8'	ND	ND	ND	ND	ND	12.1	12.1
Tank 337	NFFS0015	10-12'	ND	ND	33.1	ND	ND	77.3	110.4
Tank 337	NFFC0015 (Duplicate)	13-15'	30.5	ND	ND	ND	ND	ND	ND
Tank 337	NFFS0025	6-8'	13.7	ND	N/A	N/A	N/A	N/A	N/A
Tank 337	NFFS0025	10-12'	1560	230	N/A	N/A	N/A	N/A	N/A
10" Line	NFFS0030	3-7'	109	181	ND	3.7	2.5	17	23.2
10" Line	NFFS0031	3-7'	13.6	ND	ND	0.01	0.04	0.12	0.17
10" Line	NFFS0032	3-7'	N/A	N/A	ND	2.7	1.8	12.3	16.8
10" Line	NFFS0033	3-7'	318	81	ND	ND	ND	ND	ND
6" Line	NFFS0046	3-7'	N/A	N/A	ND	3.7	2	21.5	27.2
6" Line	NFFS0047	3-7'	91.8	246	ND	ND	0.01	0.07	0.08
6" Line	NFFS0048 ²	3-7'	52.3	ND	ND	ND	ND	ND	ND
6" Line	NFFS0054	6-8'	42.7	149	ND	2.94	1.93	16.7	21.5
6" Line	NFFS0054	10-12'	ND	ND	ND	1.21	7.77	5.8	14.8

Notes:

ND = Sample was analyzed for the specified parameter; however, concentrations were below the method detection limit.

N/A = Sample was not analyzed for the specified parameter.

1 = Samples NFFS0017 through NFFS0024 were surface soil samples collected for risk analysis; they are not included in this table.

2 = Samples NFFG0049 through NFFG0050 were groundwater samples collected from the upper fluvial deposits; they are not included in this table.

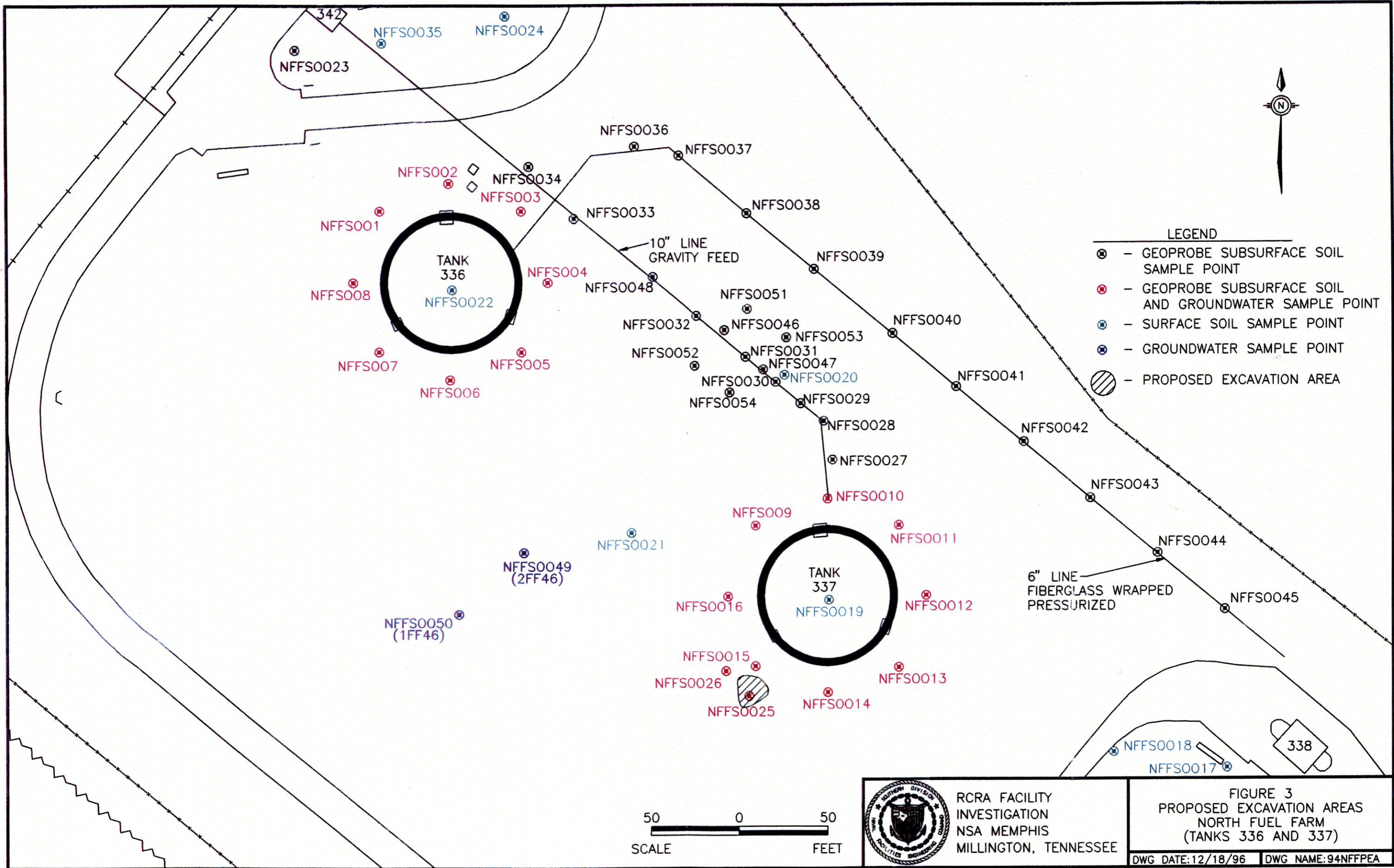
Bold = Sample concentrations exceed the TDEC Cleanup Criteria

The subsurface soil sample collected from location NFFS0015 (Figure 3) contained petroleum constituents (maximum concentration of 110 mg/kg BTEX from 6 feet to 12 feet bls). Two additional points (NFFS0025 and NFFS0026) were sampled to better define the extent of petroleum contamination. As noted in Table 4, elevated concentrations of both TPH-DRO and TPH-GRO were detected to 12 feet bls at point NFFS0025 (1,560 mg/kg TPH-DRO); however, samples collected from point NFFS0026 (approximately 15 feet south-southeast) were below the method detection limits. Based on these results, the extent of the contamination (which exceeds the TDEC Cleanup Level of 500 mg/kg TPH) adjacent to Tank 337 encompasses a horizontal area approximately 30 feet by 30 feet. The vertical extent of unsaturated soil contamination exceeding 500 mg/kg TPH is estimated to be somewhere between 10 and 15 feet bls, based on soil sampling results and estimated depth to groundwater (approximately 15 feet bls). The impacted area is shown hatched in Figure 3.

Analysis did not indicate fuel-related impacts on groundwater in the North Fuel Farm area. However, one groundwater sample, collected from 50 feet bls at location NFFS0003, contained 1,1-dichloroethene at 2.2 $\mu\text{g/L}$, which is below the 7 $\mu\text{g/L}$ maximum contaminant level (MCL) set by the USEPA. No contaminants were detected in groundwater samples collected from the previous sampling points 1FF46 and 2FF46.

PRELIMINARY RISK EVALUATION

In accordance with *Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease* (USEPA Region IV Memorandum, 1994), a PRE was conducted for the North Fuel Farm area using data from the six surface (0 to 1 ft. bls) soil samples collected during the investigation. The PRE was conducted by constructing a table for carcinogenic and systemic (noncarcinogenic) compounds. The maximum concentration for each detected constituent



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and its corresponding USEPA Region III RBC were entered into the table to calculate cumulative human health risk. However, if an inorganic's maximum concentration did not exceed its background reference concentration (E/A&H, August 1996) it was not included in the PRE. This method was used to identify chemicals of potential concern (COPCs). Proportionate risk was calculated for each COPC by comparing its maximum reported concentration to the respective RBC value. Residential and commercial scenarios were calculated separately. The USEPA default residential scenario assumes someone will live onsite and be directly exposed to the site media for 350 days a year for 30 years. For an industrial scenario, USEPA assumes that someone is exposed to the site media for 250 days a year for 25 years (*Exposure Factor Handbook*).

RBC values have been calculated by the USEPA based on an Incremental Excess Lifetime Cancer Risk (ILCR) threshold of 10^{-6} for carcinogens or a hazard quotient (HQ) threshold of 1.0 for noncarcinogens. To determine the ILCR or Hazard Index (HI), a risk ratio was calculated for each contaminant by the following equations:

$$\begin{array}{ll} \text{Carcinogenic Risk Ratio:} & RR = (\text{media concentration/screening value}) \times TR \\ \text{Noncarcinogenic Risk Ratio:} & RR = (\text{media concentration/screening value}) \times THQ \end{array}$$

where:

RR	=	the risk ratio
Media Concentration	=	the maximum concentration of a site constituent
Screening Value	=	the RBC value for that particular constituent
TR	=	target risk for RBCs
THQ	=	target HQ for RBCs

The risk ratios for each chemical were summed separately for residential and commercial scenarios to determine the overall site risk. In accordance with the PRE guidance, the cumulative ILCR threshold is 10^{-4} , and the HI threshold is 1.0. If the ILCR was greater than 10^{-4} or the HI was greater than 1.0, the site may require additional investigation for the corresponding land-use

scenario. If neither threshold was exceeded, the property may be considered suitable to lease for the specified land-use scenario.

Tables 5 and 6 summarize PRE results for the North Fuel Farm area. Both the ILCR (Table 5) and the HI (Table 6) were below the cumulative thresholds presented in the PRE guidance and the land would therefore be suitable for both residential and commercial purposes. According to the aviation-related development alternative presented in the *Base Reuse and Economic Development Plan* (RKG, 1995), the area that includes the North Fuel Farm will be used for commercial purposes.

Table 5
 North Fuel Farm — Preliminary Risk Evaluation — Carcinogens (μg/kg)

Parameter	Concentration ^a	Background Concentration ^b Reference	Screening Value ^c		Risk Ratio	
			Residential	Commercial	Residential	Commercial
Benzo(a)anthracene	290	N/A	8.80e+02	7.80e+03	3.30e-07	3.72e-08
Benzo(a)pyrene	260	N/A	8.80e+01	7.80e+02	2.95e-06	3.33e-07
Benzo(b)fluoranthene	340	N/A	8.80e+02	7.80e+03	3.86e-07	4.36e-08
Benzo(k)fluoranthene	410	N/A	8.80e+03	7.80e+04	4.66e-08	5.26e-09
Carbazole	100	N/A	3.20e+04	2.90e+05	3.13e-09	3.45e-10
Chrysene	330	N/A	8.80e+04	7.80e+05	3.75e-09	4.23e-10
4,4'-DDT	4.3	N/A	1.90e+03	1.70e+04	2.26e-09	2.53e-10
Dibenz(a,h)anthracene	54	N/A	8.80e+01	7.80e+02	6.14e-07	6.92e-08
Dieldrin	370	N/A	4.00e+01	3.60e+02	9.25e-06	1.03e-06
Indeno(1,2,3-cd)pyrene	120	N/A	8.80e+02	7.80e+03	1.36e-07	1.54e-08
PCB (Arochlor 1260)	210	N/A	8.30e+01	7.40e+02	2.53e-06	2.84e-07
ILCR					1.63e-05	1.82e-06

Notes:

- ^a = The highest detected concentration for each contaminant was used.
- ^b = Background reference concentration (RC) (2× mean background) for inorganics only. See the *Background Reference Concentration Technical Memorandum* (E/A&H, August 1996) for a discussion of RCs.
- ^c = Screening values are RBCs from the January to June 1996 RBC Table (June 3, 1996, USEPA Region III RBC memo).
- N/A = Not applicable.
- μg/kg = microgram per kilogram (ppb)

Table 6
 North Fuel Farm — Preliminary Risk Evaluation — Noncarcinogens ($\mu\text{g}/\text{kg}$)

Parameter	Concentration ^a	Background Reference Concentration ^b	Screening Value ^c		Risk Ratio	
			Residential	Commercial	Residential	Commercial
Acenaphthene	61	N/A	4.70e+06	1.20e+08	1.30e-05	5.08e-07
Anthracene	86	N/A	2.30e+07	6.10e+08	3.74e-06	1.41e-07
Benzo(g,h,i)perylene	120	N/A	2.30e+06	6.10e+07	5.22e-11	1.97e-12
Cadmium	20,300	BDL	3.90e+04	1.00e+06	5.21e-01	2.03e-02
Fluoranthene	880	N/A	3.10e+06	8.20e+07	2.84e-04	1.07e-05
Fluorene	45	N/A	3.10e+06	8.20e+07	1.45e-05	5.49e-07
Lead	58,100	19,800	4.00e+05	4.00e+05	1.45e-01	1.45e-01
Nickel	17,200	BDL	1.60e+06	4.10e+07	1.08e-02	4.20e-04
Phenanthrene	830	N/A	3.10e+06	6.10e+07	2.68e-04	1.36e-05
Pyrene	570	N/A	2.30e+06	6.10e+07	2.48e-04	9.34e-06
Styrene	2	N/A	1.60e+07	4.10e+08	1.25e-07	4.88e-09
Toluene	8	N/A	1.60e+07	4.10e+08	5.00e-07	1.95e-08
HI					0.68	0.17

Notes:

- ^a = The highest detected concentration for each contaminant was used.
- ^b = Background reference concentration (2 \times mean background) for inorganics only. See the *Background Reference Concentration Technical Memorandum* (E/A&H, August 1996) for a discussion of RCs.
- ^c = Screening values are RBCs from the January to June 1996 RBC Table (June 3, 1996, USEPA Region III RBC memo).
- N/A = Not applicable.
- BDL = Below detection limit
- $\mu\text{g}/\text{kg}$ = microgram per kilogram (ppb)

CONCLUSIONS AND RECOMMENDATIONS

Based on the information obtained during the field investigation at the North Fuel Farm, conclusions and recommendations are as follows.

Surficial Soil

Based on the PRE results, surface soil contamination onsite exceeds neither the residential nor commercial thresholds defined in USEPA guidance. Therefore, the site should be considered suitable for leasing for the intended commercial land-use purposes.

Subsurface Soil

Tank 337

Based on the elevated TPH concentrations, the area southwest of Tank 337 (see Figure 3) appears to have been impacted by a subsurface release of petroleum. The release was from 8 to 12 feet bls to an undetermined depth. Due to the absence of surface soil contamination, it is presumed that the release is related to tank leakage, rather than a surface spill.

To remediate this area and expedite the turnover of the property to meet the needs of the community, a soil removal of limited scope is recommended. An estimated 8 to 10 feet of overlying soil should be removed, screened, and segregated for later use (<100 ppm TPH) or disposal (>100 ppm TPH). The petroleum-contaminated soil could then be removed, using field screening techniques (e.g., a field infrared spectrophotometer) to define the extent of the excavation area. Samples for offsite analysis should be collected from the bottom of the excavation area to confirm contaminated soil exceeding the TDEC regulatory criteria was removed.

Groundwater

Potential contamination was detected in one of the 18 fluvial deposits groundwater samples collected (NFFG0003). The only contaminant detected in sample NFFG0003 was 1,1-dichloroethene at a concentration of 2.2 $\mu\text{g/L}$, which is less than the USEPA MCL of 7 $\mu\text{g/L}$. Based on the results of the Geoprobe groundwater sampling, no further groundwater investigation is recommended.

The recommendation is made to remove all unsaturated soil exhibiting TPH concentration over 500 mg/kg, and dispose of the excavated soil in accordance with the TDEC Special Waste Policy. An abbreviated work plan for the removal of the contaminated soil is included at Attachment C. The work plan incorporates the SOUTHNAVFACENGCOM-prepared statement of work (Attachment D). No further action or investigation is recommended for the groundwater in the North Fuel Farm area.

REFERENCES

EnSafe/Allen & Hoshall. (August 27, 1996). *Reference Concentrations Technical Memorandum*.
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EnSafe/Allen & Hoshall. (October 1994). *NAS Memphis Comprehensive RFI Work Plan*.
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RKG Associates, Inc. (August 1995). *Memphis Naval Air Station Base Reuse and Economic Development Plan*. RKG: Durham, New Hampshire.

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Southern Division, Naval Facilities Engineering Command (October 1996). *Statement of Work, Cleaning Petroleum Storage Tanks and Soil Excavation*. SOUTHNAVFACENGCOM: North Charleston, South Carolina.

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U.S. Environmental Protection Agency, Region III. (June 6, 1996). *Risk Based Concentrations Table, January-June 1996*. USEPA Region III, Philadelphia, Pennsylvania.

U.S. Environmental Protection Agency, Region IV. (1994). *Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease*. (USEPA Region IV, Atlanta, Georgia.)

Attachment A
Permeability Data Summary
North Fuel Farm (Tanks 336/337)

Table A.1
Loess Permeability Data Summary
NSA Memphis

Reference No.	Sample ID	Site	Depth	Date	Coefficient of Permeability (cm/sec)
1	NFFS005517	North Fuel Farm		03/17/97	2.20e-06
2	002S003019	002	19	02/26/96	2.30e-06
	002S002919	002	19	02/28/96	6.80e-07
3	003S000420	003	20	02/27/95	1.40e-07
4	005S000620	005	20	02/27/95	1.40e-07
5	007S001112	007	12	03/17/95	4.10e-08
	007S000922	007	22	03/13/95	9.50e-07
	007S008127	007	27	03/17/95	8.70e-07
	007S003117	007	17	03/13/95	1.60e-08
6	008G02FL05	008	05	03/13/95	3.00e-08
7	009S01DA18	009	18	02/29/96	9.60e-07
8	014S01LF10	014	10	02/22/96	4.20e-07
9	059S03UF15	059	15	03/22/96	5.70e-07
10	060S003022	060	22	02/27/95	1.70e-07
11	065S06DA16	065	16	03/01/96	4.80e-06
12	MW-02	UST 1508	7	10/92	8.40e-08
	MW-02	UST 1508	11	10/92	8.50e-07
13	MW-11	UST 1489	7	10/92	6.30e-08
	MW-11	UST 1489	11	10/92	5.50e-08
14	SB-8	Former Flying Club	10	6/93	1.10e-06
15	SB-5	Bldg. S-50	8.5	8/93	3.80e-08
	SB-5	Bldg. S-50	13	8/93	1.30e-05
16	-	UST 304/1239		2/95	8.30e-06
		Minimum Value			1.60e-08
		Maximum Value			1.30e-05
		Average Value			1.64e-06



LEGEND

1 SITE REFERENCE NUMBER

0 feet 6000



**RCRA FACILITY
INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE**

**FIGURE 1
SITE LOCATION AND
REFERENCE**

Attachment B
Analytical Summary
North Fuel Farm
NSA Memphis

North Fuel Farm Geoprobe Soil Sample Results (mg/kg)
North Fuel Farm
NSA Memphis

Area	Sample Point	Depth	Parameters						
			TPH-DRO	TPH-GRO	Benzene	Toluene	Ethyl benzene	Xylenes (total)	BTEX (Total)
Tank 336	NFFS0001	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0002	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0003	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0004	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0005	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0006	13-15'	16.4	ND	ND	ND	ND	ND	ND
	NFFS0007	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0008	13-15'	ND	ND	ND	ND	ND	ND	ND
Tank 337	NFFS0009	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0010	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0011	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0012	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0013	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0014	13-15'	ND	ND	ND	ND	ND	ND	ND
	NFFS0015	2-4'	ND	ND	ND	ND	ND	ND	ND
		6-8'	ND	ND	ND	ND	ND	12.1	12.1
		10-12'	ND	ND	33.1	ND	ND	77.3	110.4
		13-15'	ND	ND	ND	ND	ND	ND	ND
		16-18'	ND	ND	ND	ND	ND	ND	ND
	NFFC0015 (Duplicate)	13-15'	30.5	ND	ND	ND	ND	ND	ND
	NFFS0016 ¹	13-15'	ND	ND	N/A	N/A	N/A	N/A	N/A
	NFFS0025	2-4'	ND	ND	N/A	N/A	N/A	N/A	N/A
		6-8'	13.7	ND	N/A	N/A	N/A	N/A	N/A
		10-12'	1560	230	N/A	N/A	N/A	N/A	N/A
	NFFS0026	2-4'	ND	ND	N/A	N/A	N/A	N/A	N/A
		6-8'	ND	ND	N/A	N/A	N/A	N/A	N/A
	NFFS0027	3-7'	ND	ND	N/A	N/A	N/A	N/A	N/A
10" Line	NFFS0028	3-7'	ND	N/A	N/A	N/A	N/A	N/A	N/A
	NFFS0029	3-7'	ND	N/A	N/A	N/A	N/A	N/A	N/A
	NFFS0030	3-7'	109	181	ND	3.7	2.5	17	23.2
	NFFS0031	3-7'	13.6	ND	ND	0.01	0.04	0.12	0.17
	NFFS0032	3-7'	N/A	N/A	ND	2.7	1.8	12.3	16.8
		7-11'	ND	ND	ND	ND	ND	ND	ND

North Fuel Farm Geoprobe Soil Sample Results (mg/kg)
North Fuel Farm
NSA Memphis

Parameters

Area	Sample Point	Depth	TPH-DRO	TPH-GRO	Benzene	Toluene	Ethyl benzene	Xylenes (total)	BTEX (Total)
10" Line	NFFS0033	3-7'	318	81	ND	ND	ND	ND	ND
Cont'd.	NFFS0034	3-7'	ND	ND	ND	ND	ND	ND	ND
	NFFS0035	3-7'	N/A	N/A	ND	ND	ND	ND	ND
6" Line	NFFS0036	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0037	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0038	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0039	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0040	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0041	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0042	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0043	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0044	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0045	3-7'	N/A	N/A	ND	ND	ND	ND	ND
	NFFS0046	3-7'	N/A	N/A	ND	3.7	2	21.5	27.2
	NFFS0047	3-7'	91.8	246	ND	ND	0.01	0.07	0.08
	NFFS0048 ²	3-7'	52.3	ND	ND	ND	ND	ND	ND
	NFFS0051	3-7'	ND	ND	ND	ND	ND	ND	ND
	NFFC0051 (Duplicate)	3-7'	ND	ND	ND	ND	ND	ND	ND
	NFFS0052	0-4'	ND	ND	ND	ND	ND	ND	ND
		6-8'	ND	ND	ND	ND	ND	ND	ND
		10-12'	ND	ND	ND	ND	ND	ND	ND
	NFFC0052 (Duplicate)	0-4'	ND	ND	ND	ND	ND	ND	ND
	NFFS0053	0-4'	ND	ND	ND	ND	ND	ND	ND
		6-8'	ND	ND	ND	ND	ND	ND	ND
		10-12'	ND	ND	ND	ND	ND	ND	ND
	NFFS0054	0-4'	ND	ND	ND	ND	ND	ND	ND
		6-8'	42.7	149	ND	2.94	1.93	16.7	21.5
		10-12'	ND	ND	ND	1.21	7.77	5.8	14.8

Notes:

Bold = Sample concentrations exceed the TDEC Cleanup Criteria

ND = Sample was analyzed for the specified parameter; however, concentrations were below the method detection limit.

N/A = Sample was not analyzed for the specified parameter.

1 = Samples NFFS0017 through NFFS0024 were surface soil samples collected for risk analysis; they are not included in this table.

2 = Samples NFFG0049 through NFFG0050 were groundwater samples collected from the upper fluvial deposits; they are not included in this table.

Attachment C
Removal Action Work Plan
North Fuel Farm
NSA Memphis

**North Fuel Farm
Soil Removal Work Plan
NSA Memphis**

INTRODUCTION

Based on the conclusions and recommendations presented in the *North Fuel Farm Investigation Technical Memorandum*, a soil removal will be performed in the Tank 337 area. The removal will be performed by the Charleston Naval Shipyard Environmental Detachment (the Detachment) as specified in the attached Statement of Work (SOW; Attachment B) issued by the Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). All work will be performed in accordance with current TDEC guidelines using the procedures outlined in this document, as well as the SOW.

PROJECT DESCRIPTION

The Detachment will be performing several tank-related projects under the attached SOW, including cleaning and inspecting Tanks 336/337 and excavating the petroleum-contaminated soil associated with Tank 337.

SOIL REMOVAL

The removal will be conducted using either a backhoe or trackhoe to excavate the soil. The excavation area has been previously defined; however, field conditions and field observations may warrant deviations from this plan. All such deviations will be documented either by the Detachment in the tank cleaning and inspection reports, or by E/A&H personnel in the soil removal report. The actual extent of the excavation will be determined by a field screening process using the field infrared spectrophotometer (IR) which is based on USEPA Method 418.1 (total petroleum hydrocarbons). A 10 foot by 10 foot grid will be established over the floors and walls of the excavated area, with a five-point composite screening sample collected from each 10 foot by 10 foot square. The sampling grid may be adjusted to a smaller (i.e., "tighter") grid, based on the extent of the excavation. The excavation will continue until the IR readings indicate TPH concentrations of less than 500 mg/kg. The excavation may also be terminated if the total depth of the pit intercepts the water table or creates a safety hazard.

When the IR readings indicate TPH concentrations of less than 500 mg/kg, confirmation samples will be collected and sent to an offsite laboratory for analysis by USEPA Method 418.1 and Tennessee-modified USEPA Method 8015 (GRO.BTEX and DRO). Confirmation samples will be collected from the floor and walls of the excavation area. The locations will be selected based on the highest field IR readings.

The confirmation samples will be submitted for a 24-hour turn around time, during which time the excavation will remain open. The excavation area will be barricaded with safety flagging and/or barricade fencing. Upon receipt of the confirmation data, the excavation will be backfilled with clean soil and stockpiled soil exhibiting TPH concentrations less than 100 mg/kg.

Project Roles

During the soil removal activities at the North Fuel Farm, the Detachment will be tasked to:

- Clean and inspect petroleum storage tanks 336 and 337 in accordance with the SOUTHNAVFACENGCOM-prepared Specification 13219 (Attachment B).
- Remove and/or cap any associated piping.
- Excavate the petroleum contaminated soil exceeding 500 mg/kg TPH identified during the North Fuel Farm investigation.
- Arrange for the disposal of all excavated materials.
- Maintain stockpile while awaiting disposal.
- Provide tank cleaning/inspection documentation to SOUTHNAVFACENGCOM and the NSA Memphis Public Works Office.

- Provide the necessary assistance to SOUTHNAVFACENGCOM and the NSA Memphis Public Works Office, as specified in the SOW.

During the soil removal activities at the North Fuel Farm, E/A&H will be tasked to:

- Collect and analyze soil samples during the excavation process for screening purposes using the field IR.
- Collect disposal samples from any stockpiled soil associated with the soil removal in the North Fuel Farm Area.
- Collect samples from any sludges and/or rinse water associated with the soil removal in the North Fuel Farm Area.
- Collect soil samples from the excavation area to confirm that established cleanup goals have been achieved.
- Provide documentation of the removal and the confirmation sampling results, in the form of a Technical Memorandum, to the BRAC Cleanup Team.
- Provide assistance to Detachment, SOUTHNAVFACENGCOM, and the NSA Memphis Public Works Office, if necessary.

SOIL DISPOSAL

The Detachment will be responsible for obtaining all necessary disposal permits and/or approvals. E/A&H will provide technical assistance in the disposal characterization and data presentation process.

All excavated soil will be placed in stockpiles approximately 10 cubic yards in size, and will be screened using the pre-described field IR methods. All soil exhibiting field IR readings less than 100 ppm TPH (or the current TDEC petroleum contaminated soil level), will be used as backfill material. All soil exhibiting field IR levels greater than 100 ppm TPH (or the current TDEC petroleum contaminated soil level) will be placed in lined roll-off containers. The roll-off containers will be labeled indicating, at a minimum, the site of origin (e.g., Tank 337), contents (e.g., petroleum contaminated soil), and accumulation date.

Samples will be collected from each roll-off box for the disposal characterization parameters TCLP-TPH, TCLP-benzene, and TCLP-metals with a 5-working day turnaround time. The data will be provided to the Navy by E/A&H within 5-working days of receipt of data. Disposal data submittals will consist of copies of the laboratory data, as well as a concise summary.

TANK CLEANING/INSPECTIONS

Additional activities scheduled for the North Fuel Farm area include the cleaning and inspecting of Tanks 336 and 337.

Project Roles

In accordance with Specification 13219 (Attachment B), the Detachment will:

- Remove all material from Tanks 336 and 337 prior to cleaning, and dispose of this material in accordance with their approved Hazardous Waste Disposal Plan (Section 1.2.3.6 of Specification 13219) which must meet the criteria presented in Section 3.5.1 of Specification 13219.
- Clean the tanks in accordance with Section 3.5 of Specification 13219, which involves either a detergent wash/scrub, or brush-blasting (to minimize water use). Sandblasting may be used for "tenaciously adhering material" in accordance with Section 3.2.6 of Specification 13219.

- Collect and contain all rinse/wash water generated in suitable containers (i.e., DOT-approved 55-gallon drums or frac tank) and tested to determine disposal options in accordance with Section 3.5.1 of Specification 13219.
- Upon completion of the tank cleaning activities, stencil the date cleaned, along with the contractor's name, and address on the outside of the tank in accordance with Section 3.6.1 of Specification 13219.
- Restore the site to original condition in accordance with Section 3.6.2 of Specification 13219.

During the inspection and cleaning of Tanks 337 and 337, E/A&H personnel will:

- Collect samples from any sludges and/or rinse water associated with the tank cleaning activities in the North Fuel Farm Area.

ANALYTICAL REQUIREMENTS

Tanks 336 and 337 previously have contained both JP-5 and JP-8, respectively. During the soil removal process, screening samples will be collected and analyzed using a field IR. As previously stated, this method is based on the USEPA Method 418.1, which detects and quantifies a wide range of hydrocarbon constituents. When the cleanup goal of 500 mg/kg is achieved, confirmation samples will be collected and submitted for offsite analysis using USEPA Method 418.1, as well as the Tennessee-modified USEPA Methods for GRO (GRO.BTEX [TN-modified 8015.BTEX]). and DRO (DRO [TN-modified 8015]). Rush analysis (i.e., 24-hour turnaround) will be requested for these samples. The results of these confirmation samples will be compared to the TDEC remediation levels of 500 mg/kg TPH and 50 mg/kg benzene.

As outlined in the SOW, E/A&H will also collect samples for offsite analysis of any sludge and/or rinse water generated during the cleanup activities at the North Fuel Farm. Sludge samples will be analyzed for the disposal parameters pH, flashpoint, Toxicity Characteristic Leachate Procedure (TCLP)-TPH, TCLP-benzene, and TCLP-Metals, using the methods presented in Table C-1. Rinse water disposal analyses will consist of oil and grease and VOCs, based on the assumption that the rinse water will be discharged via an oil/water separator to the sanitary sewer system. A 10-working day turnaround time will be requested for sludge samples and rinse water samples.

Table C-1
North Fuel Farm Soil Removal
Analytical Requirements

Source	Matrix	Method
Excavation Screening Samples	Soil	TPH — Field IR
Excavation Confirmation Samples	Soil	TPH — USEPA Method 418.1 TPH-GRO — TN Modified 8015.BTEX TPH-DRO — TN Modified 8015
Soil Disposal Samples	Soil	TCLP-TPH TCLP-Benzene TCLP-Metals
Tank Sludge, if necessary	Sludge	pH Flashpoint TCLP-TPH TCLP-Benzene TCLP-Metals
Rinse Water	Water	Oil and Grease Volatile Organic Compounds

All data received by E/A&H will be summarized with two copies forwarded to the NSA Memphis Public Works Office for distribution to the Detachment within five-working days of receipt.

HEALTH AND SAFETY

E/A&H personnel will follow the procedures outlined in Section 7 of the *Comprehensive RFI Work Plan* (E/A&H, 1994). The Detachment will provide their own health and safety plan which should outline all worker safety issues (i.e., air monitoring, exposure limits, action levels), as well as site security issues (i.e., barricades, etc.).

Attachment D
Statement of Work
Cleaning Petroleum Storage Tanks
NSA Memphis

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
2155 EAGLE DRIVE, P.O. BOX 190010
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

CONTRACT N62467-_____
STATEMENT OF WORK
SOW NO. _____

NAVAL SUPPORT ACTIVITY MEMPHIS, TN

CLEANING PETROLEUM TANKS
AND SOIL EXCAVATION

SECTION 1 - Project Description and Background

- 1.1 The objective of this scope of work is to accomplish the following at NSA Memphis:
 - 1.1.1 Clean petroleum storage tanks , USTs 336, 337 at the North Fuel Farm and ASTs 1717, 1718, 1719, 1720, oil water separator 1722 at the Carrier Deck. Tank 1754 to be triple rinsed only.
 - 1.1.2 Excavate all of the piping ancillary to USTs 336, 337 and the fuel stands. Cut or blank off at valve piping to the tanks at tank interface. Excavate petroleum contaminated soils to clean up the (3) sites. Site locations as shown in Fig.3, enclosure (1). Backfill, compact soil (95%), and seed the areas.
- 1.2 The sampling of soils (stockpiled and tank pits), tank contents (sludges and liquids), rinse water and closure documentation will be accomplished by EnSafe/Allen Hoshall under a separate contract.
- 1.3 The tank cleaning to be accomplished per SOUTHDIV Specification #13219, enclosure (2).
- 1.4 Soil excavation will be accomplished in accordance with Tennessee Department of Environment and Conservation (TDEC) guidelines.

- 1.5 Sections 2 and 3 of this statement of work describe the generic requirements of the work to be performed. Section 4 describes specific work to be performed by the AE.

SECTION 2 - Special Instructions

- 2.1 The Contractor (SPORTENVDETHASN) is responsible for recording all minutes of meetings and provide a copy of the minutes to the remedial project manager, and activity's environmental coordinator..
- 2.2 The Contractor is responsible for obtaining permission and clearance from the appropriate station security personnel to enter and perform the required work.
- 2.3 The Contractor shall forward all submissions to activity's environmental coordinator and to SOUTHNAVFACENCOM, Code 1846. Submissions include storage tank cleaning reports, chain of custody, sludge and solid waste disposal manifests, associated photographs, drawings, registration forms, etc..
- 2.4 The Contractor shall schedule a meeting at NSA Memphis prior to contract award to discuss all phases of this work package and inspect the sites. This is necessary to facilitate the cost proposal.
- 2.5 Notify the activity environmental coordinator prior to making any visits to the site.

SECTION 3 - Applicable Documents

- 3.1 The following documents to be used in the cleaning of the tanks.
- 3.1.1 Cleaning Petroleum Storage Tanks, API Publication 2015, latest revision..
- 3.1.2 Interior Lining of Underground Storage Tanks, API Recommended Practice 1631, latest edition.
- 3.1.3 Safety and Health and Health Requirements Manual, US Army Corps of Engineers, EM 385-1-1, latest edition.
- 3.1.4 SOUTHDTV Guide Specification 13219,
- 3.1.5 TDEC CHAPTER 1200-1-15, Underground Storage Tank Program.
- 3.1.6 Technical Memorandum, EnSafe/Allen & Hoshall, Sep. 20, 1996.

SECTION 4 - Description of Work

- 4.1 Schedule a meeting at NSA Memphis to inspect all of the sites, plan the work and discuss the work plan prior to submittal of a cost proposal..

- 4.2 Tank cleaning to be in accordance with SOUTHDIV Specification 13219, enclosure (2) and applicable documents in Section 3..
- 4.2.1 Clean the 420,000 gallon steel petroleum underground storage tank #336 at the N-94 Fuel Farm. Tank was used to store JP-5 fuel.
- 4.2.2 Clean the 420,000 gallon steel petroleum underground storage tank #337 at the N-94 Fuel Farm. Tank was used to store JP-8 jet fuel..
- 4.2.3 Clean tanks at the Carrier Deck:
 - 4.2.3.1 Aboveground storage tank (AST) # 1717, a 10,000 gallon steel JP-5 jet fuel storage tank.
 - 4.2.3.2 AST # 1718, a 10,000 gallon stainless steel AFFF fuel storage tank..
 - 4.2.3.2 AST # 1719, a 50,000 gallon stainless steel JP-5 jet fuel storage tank.
 - 4.2.3.3 AST # 1720, a 2,000 gallon steel JP-5 jet fuel storage tank.
 - 4.2.3.4 AST # 1722, a 20,000 gallon concrete oil water separator.
 - 4.2.3.5 Tank 1754 to be triple rinsed only.
- 4.3 After cleaning each tank, inspect the tanks for damage .
- 4.4 For each tank, prepare a tank cleaning/inspection report to document all phases of the work.
- 4.5 Furnish all labor, materials, and equipment necessary to accomplish the work, i.e., trackhoe, trucks, drums, frac tanks, plastic sheeting , bales of hay, etc..
- 4.6 Tanks 1718, 1719, 1720, 1722 at the Carrier deck to be cleaned first.
- 4.7 Sludges shall be drummed, drums shall be labeled as to content. Sludges to be disposed of through the activity's DRMO. Contractor to provide transportation.
- 4.8 Provide daily progress reports to the activity's environmental coordinator.
- 4.9 During pump out of tanks, separate the fuel, water, and sludges. DRMO may recycle the fuel and save on disposal cost. Water, after confirmatory testing, may be discharged into the activity's oil water separator.
- 4.10 Excavate all the piping ancillary to tanks 336 and 337 and the fuel stands. Backfill excavation with clean dirt, compact and seed the area.

- 4.11 Excavate all of the petroleum contaminated soils identified in technical memorandum, enclosure (1). Backfill excavations with clean soil, compact to 95% and seed the area.
- 4.12 A safety and health plan is required for the work in this scope of work.
- 4.13 SPORTENVDETCHASN to provide a confined space entry harness with exception of respirator to station personnel to inspect the tanks.
- 4.14 All completed work to be approved by the stations environmental coordinator or SOUTHDIV.
- 4.15 All sampling of soils, sludges, rinse water, and excavation pits will be accomplished by EnSafe/Allen & Hoshall.

SECTION 5 - ENCLOSURES

- (1) TECHNICAL MEMORANDUM, EnSafe/ Allen & Hoshall, Sep. 20, 1996
- (2) GUIDE SPECIFICATION, SECTION 13219, SOUTHDIV.

SECTION 6 - Submittals

- 6.1 Any deliverable generated during the storage tank cleaning project shall be forwarded to the RPM and the activity point of contact (two copies each).

SECTION 7 - Addresses

7.1 Commanding officer
Attn.: Code 1846
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive, P.O. Box 199910
North Charleston, SC 29419-9010

POC: John Karlyk
(803) 820-5624

7.2 Commanding Officer
Attn.PWD Environmental
Naval Support Activity, Memphis
Millington, TN 38054-5000

POC: Mr. Randy Wilson
(901) 873-5462

7.3 EnSafe/Allen & Hoshall
Shelby Oaks Plaza
5909 Shelby Oaks Drive
Suite 201
Memphis, TN, 38134

POC: Mr. John Stedman, Jr.
(901) 372-7962